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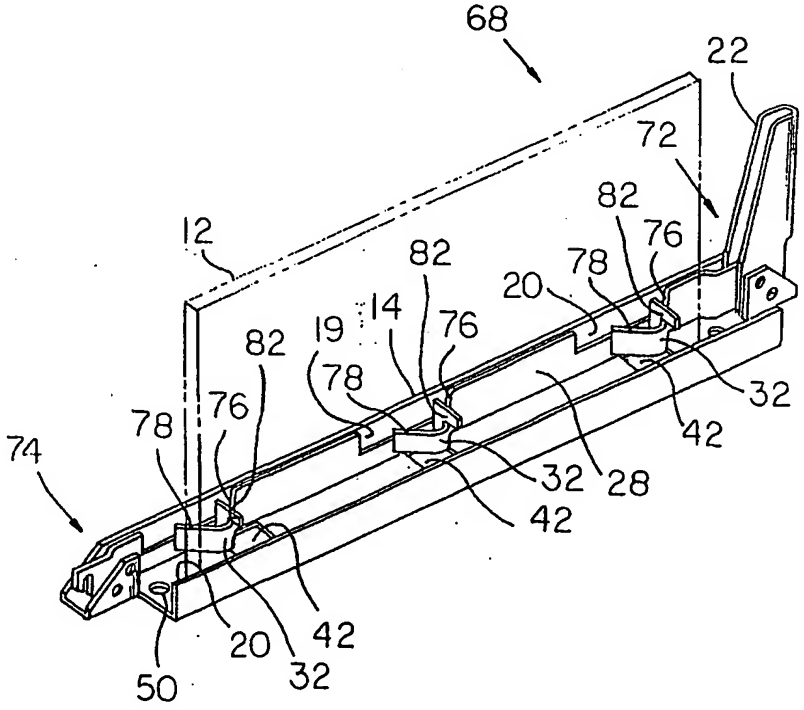
(54) Title: ZERO INSERTION FORCE CIRCUIT BOARD RETAINER

(57) Abstract

A board retainer assembly including a chassis member, a clamp member slidably retained within the chassis member, a wedge actuator, a biasing element fixedly mounted on the chassis member, and a board contact element carried by the clamp member between a clamped configuration and an unclamped configuration. The biasing element and the contact element wedgedly and resiliently co–act so that the contact element, in the clamped configuration, is wedgedly and resiliently urged against the margin of a board which is received in the retainer assembly. The wedge actuator drives the clamp member generally linearly along a path within the chassis member between the clamped and unclamped configurations. The wedge actuator is mounted for pivotal movement between a locked position wherein the contact element is resiliently urged against the board in an interference fit, and an unlocked position wherein the contact element is in the unclamped configuration.



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ZERO INSERTION FORCE CIRCUIT BOARD RETAINER

BACKGROUND OF THE INVENTION

1. Field of the invention.

The invention relates in general to board retainers and, in particular, to a zero insertion force circuit board retainer assembly which requires no tools to actuate.

2. Description of the prior art.

Previously, there had been attempts to retain printed circuit boards, and other planar objects, with zero insertion force on the circuit board or object. Blomquist U.S. Pat. No. 5,200,882, Husted U.S. Pat. No. 4,979,073, Husted et al. U.S. Pat. No. 4,502,601, and Spurling et al. U.S. Pat. No. 3,975,805, for example, all relate to devices for retaining the edge of a printed circuit board by use of a cam rod rotated against a resilient spring within a specially configured groove of an elongated body or cold wall. The devices of these prior patents generally required precision machined parts to maintain uniform heat dissipation characteristics between the printed circuit board and the retainer. The devices of these prior patents also generally required a special tool to lock and unlock the printed circuit board, which had to be produced and inventoried, and created the possibility of damaging electronics in the vicinity of the device when inserting

the tool. In addition, the position in which the special tools needed to be placed to lock and unlock the circuit board was often difficult to reach, particularly so in compact electronic racks where there was limited room to reach between a stack of circuit boards within the rack. Other prior expedients proposed to retain printed circuit boards, and other planar objects, with zero insertion force on the circuit board or other objects required a number of parts. For instance, U.S. Pat. No. 4,644,444 utilized expanding jackscrews, closed rings, split rings and a fixed nut to exert a clamping force against the edges of the printed circuit board. To unlock a circuit board using the device of U.S. Pat. No. 4,644,444 required the use of a wrench to loosen the screw, again creating the possibility of damaging electronics in the vicinity of the device when inserting and manipulating the wrench.

There is a need for a zero insertion force retainer device that easily locks and unlocks circuit boards and the like in place without the use of any tools. There is also a need for a zero insertion force retainer device that is inexpensive to make and can be adapted for left hand or right hand locking without the need for producing parts which are only suited to either left or right hand assemblies. These needs are not fulfilled by those retainers which require precision machined parts, nor by any of the other proposed prior expedients.

Those concerned with these problems recognize the need for a simple and inexpensive zero insertion force retainer device that does not require special tools or precision machined parts, and can be assembled for right or left hand actuation without the need for special right or left hand parts.

BRIEF SUMMARY OF THE INVENTION

These and other difficulties of the prior art have been overcome according to the present invention. The present invention comprises a zero insertion force board retainer assembly adapted to being mounted to a rack in an electronic chassis and the like to facilitate the quick and easy insertion and extraction of boards and the like, without the use of tools. The retainer assembly, according to the present invention, can be manipulated manually by an operator. The operator manually moves a latch member between clamped and unclamped configurations. The latch member is mounted to and a part of the retainer assembly.

The present invention contemplates a retainer assembly which includes, among other things, a chassis member, or the like, which is intended to be permanently mounted to a cold wall or other supporting surface, and is configured to receive the edge of a planar object. Slidably mounted within the chassis member is a clamp member which is adapted to be slidably moved between clamped and unclamped

configurations with respect to the margin of a board which is received in the chassis member. Such movement is controlled by a wedge actuator or latch member which is pivotally and permanently mounted to the retainer assembly.

At least one of the chassis or clamp members includes resilient contact elements which, when activated by the movement of the clamp member, react against biasing elements on the opposed structure so as to resiliently engage the edge of a board. The necessary resilience can be provided by either or both of the contact elements or the biasing elements. Preferably, one of the contact or biasing elements is substantially rigidly mounted and the other flexes as it is moved wedgedly over it. Suitable resilience is provided, for example, by forming one or both of the contact and biasing elements as leaf spring members.

In general, the components of the retainer assembly are preferably formed from stamped sheets or plates of metal. The design is such that precision machining of the parts is unnecessary, and simple sheet metal stamping and forming operations are sufficient. The wider tolerances which are inevitably present in the stamped and formed retainer assembly according to the present invention are accommodated by a relatively wide range of deflection which is provided by the resilient elements.

In a preferred embodiment of the present invention, the retainer assembly generally comprises a chassis member

which can be mounted to any rigid structure, a clamp member which is slidably received in a channel in the chassis member, and a wedge actuator pivotally attached to at least one of the clamp member or the chassis member. The wedge actuator acts to move the clamp member relative to the chassis member when it is rotated between locked and unlocked positions. The chassis member is, for example, a generally U-shaped structure having two generally parallel opposed sides and a base portion. The open side of the generally U-shaped channel which is defined by the U-shaped chassis member is adapted to receive the edge of a generally planar object. One such opposed side preferably acts as a circuit board clamping surface. The chassis member also includes, for example, bearing tabs which are generally positioned at a fixed location between the opposed sides, and can extend, for example, from the central or base portion of the generally U-shaped structure. The preferably fixed bearing tabs are generally positioned so as to wedgedly co-act with resilient spring elements which are carried by the clamp member. When the wedge actuator is rotated from its unlocked or unclamped position to its locked or clamped position, the clamp member slides relative to the chassis member generally within the generally U-shaped channel so as to cause the fixed bearing tabs to act wedgedly against the resilient spring elements. The resilient spring elements are forced

by the wedging action toward one of the opposed sides and into resilient engagement with the edge of a planar object which is received within the generally U-shaped channel. The planar object, for example, a circuit board, is thus clamped to the retainer assembly. The edge of the planar object is released by moving the wedge actuator from the locked to the unlocked position. This causes the clamp member to move slidably relative to the chassis member. The resilient spring fingers are substantially withdrawn from wedging engagement with the bearing tabs by the movement of the clamp member. The edge of the circuit board is thus released. When the resilient spring fingers are withdrawn from wedging engagement with the bearing tabs, the edge of a circuit board may be inserted or withdrawn from the retainer assembly with zero force.

The wedge actuator or latch member is preferably permanently mounted to an end of the retainer assembly so that it can not be misplaced or fall into the electronic equipment. The wedge actuator generally includes an elongated arm which provides sufficient area for the operator's fingers to manipulate the actuator between the locked and unlocked positions. The wedge actuator is generally pivotally mounted to the chassis member and acts on the clamp member through, for example, an offset pivotal connection or a cam surface engaged by a surface of the clamp member, to cause the clamp member and bearing tabs to

wedgedly co-act.

When assembled, the clamp member is, for example, slidably trapped within a channel which is conveniently defined, for example, by tabs or flaps which are partially incised from but still unitary with the chassis member, and bent to form a channel with one of the opposed sides of the chassis member.

In a further embodiment of the present invention the wedge actuator can be pivotally installed at either a right or left hand end of the chassis member or clamp body. In this embodiment, the wedge actuator is also pivotally attached to either the right or left hand end of the clamp member, as desired, at a location which is offset from the pivotal connection to the chassis member. The travel or throw of the clamp member relative to the chassis member is determined by the amount of offset between the two pivotal connections. The wedge actuator, for one embodiment of the pivotal connection, includes an additional pin which engages a slot provided in either end of the clamp member to provide the pivotal movement necessary to bias the resilient spring members against the board. The configuration of the components are all the same for either the right or left handed embodiments. By providing mounting elements at both ends of the retainer assembly, and configuring the interface between the spring elements and the fixed bearing tabs so that they react

bidirectionally, the only structural difference between the left and right handed embodiments is the location of the wedge actuator. The size of the bearing tabs are minimized to increase the surface area of the mounting surface of the chassis member body and thus optimize the transfer of heat from the board to the object to which the assembly is mounted.

Each part of the present invention is simply made by stamping and bending sheet material into the desired configuration, and assembly is completed by pivotally and permanently mounting the wedge actuator to the chassis member. Preferably, the permanent mounting of the wedge actuator also serves to hold the clamp member permanently assembled with the chassis member. By making and assembling the retainer assembly in this way, it has been found that manufacturing costs and assembly costs are markedly reduced compared to the expedients proposed by the prior art. By providing an assembly capable of having the wedge actuator mounted on the right or left end of the chassis member without right or left hand tooling further substantially reduces manufacturing costs and makes the assembly adaptable for use in both right and left hand applications.

Other objects, advantages, and novel features of the present invention will become apparent from the following detailed description of the invention when considered in

conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention provides its benefits across a broad spectrum of zero insertion force board retainers. While the description which follows hereinafter is meant to be representative of a number of such applications, it is not exhaustive. As those skilled in the art will recognize, the basic apparatus taught herein can be readily adapted to many uses. It is applicant's intent that this specification and the claims appended hereto be accorded a breadth in keeping with the scope and spirit of the invention being disclosed despite what might appear to be limiting language imposed by the requirements of referring to the specific examples disclosed.

Referring particularly to the drawings for the purposes of illustration only and not limitation:

Fig. 1 is a perspective view of a first preferred embodiment of the invention with a circuit board clamped in place.

Fig. 2 is a partially broken perspective view of the chassis member or clamp body of the preferred embodiment shown in Fig. 1..

Fig. 3 is a section view through the chassis member or clamp body taken along line 3-3 in Fig. 2

Fig. 4 is a perspective view of a latch member or

wedge actuator according to the preferred embodiment shown in Fig. 1.

Fig. 5 is partial plan view of a wedge actuator taken along line 5-5 in Fig. 4, showing the profile of a locking cam surface in greater detail.

Fig. 6 is a perspective view of a clamp member or spring clamp of the preferred embodiment shown in Fig. 1.

Fig. 7 is a perspective view of another preferred embodiment of the present invention.

Fig. 8 is a perspective view of a clamp member or spring clamp of the preferred embodiment shown in Fig. 7.

Fig. 9 is a perspective view of a chassis member or clamp body of the preferred embodiment shown in Fig. 7.

Fig. 10 is a section view through the chassis member or clamp body taken along line 10-10 in Fig. 9

Fig. 11 is an exploded perspective view of the wedge actuator, chassis member, and spring clamp, of the preferred embodiment shown in Fig. 7.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings wherein like reference numerals designate identical or corresponding parts throughout the several views and embodiments shown. A first preferred embodiment is shown in Figs. 1 through 6, and a second preferred embodiment is shown in Figs. 7

through 11.

Referring to the embodiment in Fig. 1, there is illustrated generally at 10 a board retainer assembly or quick release circuit board retainer assembly, shown gripping an edge of a circuit board 12. An elongated chassis member or clamp body 14 has a first opposed side 16 and a second opposed side 18 which extend generally parallel to each another. A margin of circuit board 12 is clamped against the circuit board clamping surface 20 on the first opposed side 16. The latch member or wedge actuator 22, shown in locked position, is pivotally engaged with the second opposed side 18 and the guide wall 24 with a through pin 26. Shown in phantom line is the wedge actuator 22 in the unlocked position. A clamp member 28 is slidably confined within the channel 30 of the chassis member 14. The channel 30 is defined by the adjacent wall of the second opposed side 18 and bent up tabs or flaps, for example, the guide wall 24 and the bearing wall 44. The clamp member 28 has at least one cantilever mounted spring element or finger 32 which is wedgedly associated with a biasing element or bearing tab 34. The bearing tab 34 is formed by partial incision from, and is therefore substantially rigidly unitary with, the chassis member 14. When the wedge actuator 22 is in the unlocked position, the clamp member or spring clamp 28 carries no load, and the edge of the circuit board 12 can be placed against the

circuit board clamping surface 20 and bottom wall 21 with zero insertion force. As the wedge actuator 22 is moved to the locked position, the clamp member end 36 is acted on by the lock cam surface 38 which loads the spring fingers, a typical one of which appears at 32, wedgedly against the bearing tabs, typical ones of which are illustrated at 34. As the clamp member end 36 is acted on by lock cam surface 38 to move the spring clamp 28 longitudinally within the channel 30 spring finger 32 bears against and is deflected by fixed bearing tabs 34. The thusly deflected spring finger 32 bears firmly and resiliently against the adjacent face of circuit board 12. The margin or edge of circuit board 12 is thus clamped by spring finger 32 against clamping surface 20. As the wedge actuator 22 is moved back to the unlocked position, the spring finger 32 returns to its non-deflected shape in which the circuit board 12 can be freely removed. Preferably, the portion of the spring finger which contacts the margin of the circuit board is generally approximately flat, at least under tension in contact with the board. The use of a contact area spreads the load so that the margin of the circuit board is not damaged by the concentration of the clamping force on a line or point. Also, the larger frictional area of engagement promotes the security of the engagement between the retainer assembly and the circuit board, and enhances heat transfer.

In the first embodiment referred to for purposes of illustration only, and not limitation, Figs. 2 and 3 show the chassis member 14 in greater detail. For purposes of clarity, the second opposed side 18 is shown mostly removed in Fig. 2 with the upper edge of the removed portion shown in phantom. The chassis member 14 is formed, for example, from a single sheet material, such as resilient steel. The first and second opposed sides, 16 and 18, are formed by bending the sheet material upward to form a generally U-shaped channel indicated generally at 40. The guide wall 24 is formed by incising a portion of the sheet material along all but one edge and bending the tab which is thus formed into a parallel relationship with the adjacent face of the second opposed side 18. The wedge actuator mounting holes 41 and 43 are respectively line drilled into the guide wall 24 and the second opposed side 18. The bearing tab 34 is formed by incising a pattern 42 in the bottom wall 21 of chassis member 14 and bending the bearing tab 34 to the position and configuration shown. The bearing tab 34 is formed in three bending operations. The first bend is made upward and generally at 90 degrees which establishes the bearing wall 44 that is generally parallel with the first opposed side 18. The second bend is made at generally 90 degrees to establish the bearing tab 34, shown in Figs. 1-3. The bearing tab 34 extends generally perpendicular to the first opposed side 18. The third bend

of 90 degrees establishes the cage element 48. The inside surface of the first opposed side 18, the guide wall 24, the bearing wall 44, and the other incised tabs, cooperate to define the channel 30 wherein the clamp member 28 is received when the retainer assembly is completely assembled. When completely assembled, bearing wall 44, guide wall 24, cage elements 48 and wedge actuator 22 cooperate to slidably confine the clamp member 28 within the channel 30. The retainer mounting holes 50 are provided to allow fixed mounting of the board retainer assembly 10 to any suitable rack or frame, preferably in heat exchanging relationship.

The wedge actuator 22 of the first preferred embodiment is shown in Figs. 4 and 5 in greater detail. In this embodiment, referred to for purposes of illustration only, and not limitation, the wedge actuator 22 is formed from sheet material, such as resilient steel. A suitable material providing successful results, for example, is .025 inch thick cold rolled steel per AISI-C-1010. The wedge actuator 22 functions as an over the center detent mechanism for the board retainer assembly. The wedge actuator 22 has a elongated arm 52 with a outwardly bent handle 54 for providing a sufficient area for an operator's fingers to engage and move the wedge actuator between the locked and unlocked positions. The wedge actuator 22 includes the lock cam surface 38 adjacent

to the bottom edge 60 of the elongated arm 52. Near bottom edge 60 of the elongated arm 52 is a pivot hole 62. The center 64 of the pivot hole 60 is shown in Fig. 5. The lock cam surface 38 includes a arcuate surface 56 and a flat surface 58. The arcuate surface 56 is semi-circular and has a radial center 66 which is offset from the center 64 of the pivot hole 62. The amount of this offset establishes the extent of the generally linear excursion which the clamp member 28 will experience when the wedge actuator 22 is moved between the unlocked and locked positions. The amount of caming movement which the clamp member or spring clamp 28 will undertake is established by the amount of this offset. Locking is accomplished, for example, by locating radial center 66 relative to center 64 so that the wedge actuator 22 is in a slightly over center position in the fully locked configuration.

The clamp member 28 of the first preferred embodiment is shown in greater detail in Fig. 6. The clamp member 28 is formed from sheet material, such as, for example, resilient steel. In this embodiment, referred to for purposes of illustration only, and not limitation, the spring fingers 32 are a generally J-shaped resilient spring made from, for example, 301 stainless steel 0.025 inch thick. The spring fingers 32 are formed, for example, by incising along all but one edge of the clamp member 28, and deforming them to the desired configuration. In this

embodiment a generally J-shaped configuration is desired, however other configurations are contemplated as well. The clamp member 28 has a flat surface 70 which slidably engages one internal wall of channel 30 of the chassis member 14 when the retainer is completely assembled. The opposed face of clamp member 28 engages the opposing wall of channel 30. According to the present invention in this first embodiment, for each spring finger 32 there is a corresponding bearing tab 34 in the chassis member 14. Two corresponding sets of spring fingers and bearing tabs are illustrated. As those skilled in the art will appreciate, there can be one, or any number of, corresponding sets of spring fingers and bearing tabs without departing from the true scope and spirit of the present invention. As those skilled in the art will appreciate, the number of corresponding sets of spring fingers and bearing tabs will depend on the application, and more particularly on the length of the circuit board or planar object that is desired to be retained.

The first embodiment illustrated in Fig. 1 is assembled by first placing the clamp member 28 into the channel 30 of the chassis member 14. The wedge actuator 22 is inserted between the guide wall 24 and the second opposed side 18 in the unlocked position which is shown in phantom line. The through pin 26 is inserted through the mounting hole 43 of the second opposed side 18, the pivot

hole 62 of the actuator 22, and the mounting hole 41 of the guide wall 24. The through pin 26 is then fixed in place by deforming both ends against the guide wall 24 and the second opposed side 18, respectively. The clamp member 28 is slidably retrained in the channel 30 by the bearing tabs 34, the cage elements 48, the bearing walls 44, the second opposed side 18, and the wedge actuator 22. The dimensions of the chassis member 14, the actuator 22, and the clamp member 28 are selected so that, to retain a desired circuit board of a particular thickness, the interference tolerance between the spring fingers 32 and circuit board clamping surface 20 in the actuated configuration is, for example, between 0.005 to 0.020 inches. In the first embodiment, the actuator has an offset between the center 64 of the pivot hole 62 and the radial center 66 of the curved surface 58 of, for example, approximately 0.10 to 0.15 inches. With a circuit board positioned between the circuit board clamping surface 20 and the spring fingers 32, as the wedge actuator is brought from the unlocked position to the locked position, the lock cam surface 38 loads the clamp member end 36 until the flat surface 58 snappedly engages the clamp member end 36 when the over the center locked position is achieved. This snapped engagement acts to prevent the wedge actuator 22 from releasing back to the unlocked position.

Utilizing the above described materials and

tolerances, a satisfactory gripping force on the margins of circuit boards used in computer equipment has been achieved. This embodiment can be repetitively locked and unlocked without the use of tools, and without degradation of the gripping force. In addition, by forming this preferred embodiment from sheet material, it has been discovered that the expense of producing the present invention is much less compared to producing machined circuit board retainers, often precisely machined, as proposed by the prior art.

Referring to Figs. 7 through 11, a second preferred embodiment of the present invention is shown wherein like reference numerals designate corresponding parts with the first preferred embodiment of Figs 1-6. In Fig. 7, there is illustrated generally at 68 a universal board retainer assembly or universal quick release circuit board retainer assembly wherein the latch member or wedge actuator 22 can be mounted at either the right or left ends of the assembly, generally indicated at 72 and 74, respectively. A significant feature of this embodiment is that the same latch member 22 can be mounted at either end of the assembly, 72 or 74, without effecting the ability of the assembly to retain a circuit board. This feature eliminates the need for special right and left hand tooling which lowers the costs associated with mass producing the assemblies. Also, the openings or patterns 42 left in the

chassis member in the second preferred embodiment are significantly reduced in size compared to the corresponding openings or patterns 42 left in the first preferred embodiment. This increases the rate at which heat can be conducted through the assembly of the second preferred embodiment into the supporting structure as compared to the first preferred embodiment. The second preferred embodiment of the present invention is particularly well suited to applications which require heat to be transferred from the retained board to an object to which the assembly is attached.

In the embodiment of Figs. 7-11, the chassis member or clamp body 14, the clamp member or spring clamp 28, and latch member or wedge actuator 22 are formed in substantially the same manner as discussed with reference to the embodiment of Figs 1-6, that is, by making incisions in, for example, a 0.025 inch thick stainless steel sheet and bending the sheet into the configurations shown. In Fig. 8, the clamp member 28 has cantilevered spring elements or fingers 32 formed by incising portions of the sheet material and bending them into a generally V-shaped configuration. The V-shaped configuration of each spring finger 32 provides it with two sides, 76 and 78, which are bent to establish a substantially 90 degree angle therebetween. Each side thus extends at a substantially 45 degree angle with respect to the flat surface 70 of the

clamp member 28. Other angles are contemplated, however all that is needed is that the angle of each side, 76 and 78, with respect to the flat surface 70, be substantially the same, that is the sides are generally symmetrical with respect to the biasing element. This is desirous in order to assure that the amount of deflection of the spring finger is substantially the same without regard to whether the latch member is mounted on the right end 72 or the left end 74.

In Figs. 9 and 10, the chassis member 14 of the second preferred embodiment is shown. The bearing tabs 34 are formed by making incisions in the bottom portion 80 of the chassis member 14. Minimizing the size of the bearing tabs reduces the size of the opening(s) or pattern(s) 42, which in turn improves the heat transfer characteristics of the universal assembly 68. Each bearing tab 34 has a protruding extension 82 for engaging the upper edges 76 and 78 of a respective spring finger. When assembled, the protruding extensions 82 slidably confine the spring clamp 28 within the channel 30 (see particularly Figs. 7 and 10). The channel 30 of the chassis member 14 is established between the inner face 19 of second opposed side 18 and each retaining edge 84 of each bearing tab 34 (see particularly Figs. 9 and 10).

In Fig. 7, the latch member 22 is shown attached to the right end 72 of the assembly and in the locked

position. In this configuration, when the latch member 22 is moved from the unlocked position to the locked position, the clamp member 28 is slidably moved through channel 30 from the right towards the left end of the assembly and the side 76 of the spring fingers wedgedly engage fixed biasing member 86 of the bearing tabs causing the cantilevered spring fingers to deflect toward the circuit board clamping surface 20. If the latch member 22 were to be attached to the left end 74 and moved from the unlocked position to the locked position, the clamp member would be slidably moved from the left toward the right side of the assembly and sides 78 would engage fixed biasing member 86 causing the spring fingers to deflect toward the clamping surface 20. As can be appreciated, the universal board retainer assembly of the second embodiment can firmly and properly grasp a circuit board when the latch member is attached to either side of the assembly.

The second preferred embodiment accomplishes the linear movement of the clamp member 28 by pivotally pinning the clamp member 28 to the wedge actuator 22 by means of a pin 88. Referring to Fig. 11, the pin 88 extends through the first and second aligned holes, 90 and 92, in the latch member 22. Within central portion 94 of the latch member the pin 88 engages a slot 96 provided in the end of the clamp member 28. The clamp member 28 and wedge actuator 22 are then installed within the chassis member 14 and pin 26

is installed to pivotally capture the assembly. The pin 26 is inserted through line drilled holes 102 of the chassis member 14 and through line drilled holes 104 of the latch member. The pin is then fixed in place, for example, by deforming both its ends against holes 102 of the chassis member 14. It is to be noted that in this embodiment the cam surface locking mechanism of the first preferred embodiment has been replaced with the pin 88 engaging the slot 96 of the end of the clamp member 28 to perform the same locking/unlocking motion of the assembly. Locking is further accomplished in this embodiment, for example, by providing two outward protrusions 98 on opposed sides of the latch member 22 that snappedly engage holes 100 in the end of the chassis member when the latch member is brought to the locked position. Those skilled in the art will realize that there are various means available for converting the rotary motion of the wedge actuator 22 into linear movement of the clamp member 28, only two of which have been described in detail herein. All that is required, according to the present invention, is to provide sufficient movement of the integrally mounted wedge actuator 28 to produce the desired amount of generally linear movement of the clamp member 28. This generally linear movement in turn causes a predetermined amount of deflection of the contact elements which provide sufficient resilient wedging engagement with the circuit board when it

is positioned against the clamping surface 20.

According to one preferred embodiment where the contact elements comprise cantilever mounted leaf springs resiliently carried by the clamp member, they are resiliently deflected by wedging contact with substantially rigid biasing elements mounted to the chassis member so that the generally flat faces of the contact elements engage with and clamp the margin or edge of the board 12 against surface 20. Those skilled in the art will also realize that there are detent mechanisms available to hold the wedge actuator in the locked position other than those which are illustrated.

What has been described are preferred embodiments in which modifications and changes may be made without departing from the spirit and scope of the accompanying claims. Obviously, many modifications and variations of the present invention are possible in light of the above teachings. It is therefore to be understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically described.

WHAT IS CLAIMED IS:

1. A board retainer assembly, comprising:

a chassis member including a board clamping surface;

at least one biasing element;

a wedge actuator actuatably attached to said chassis member, said wedge actuator being moveable between a locked position and an unlocked position;

a clamp member slidably assembled with said chassis member and including at least one contact element disposed in resilient wedging relationship with said biasing element, said clamp member being adapted to being slidably actuated by moving said wedge actuator between said locked and unlocked positions, said contact element being adapted to wedgedly cooperate with said biasing element to resiliently clamp said board against said clamping surface when said wedge actuator is in said locked position, and to release said board when said wedge actuator is in said unlocked position.

2. A board retainer assembly of claim 1 including a lock cam surface on said wedge actuator member, said lock cam surface comprising an arcuate surface adjacent to a flat surface, said surfaces being adapted to engage a mating surface of said clamp member, said flat surface snappedly engaging said mating surface when said wedge actuator is in said locked position.

3. A board retainer assembly of claim 1 wherein said clamp member includes an elongated body carrying at least two of said contact elements, said contact elements comprising resilient spring members extending outwardly from said elongated body toward said board clamping surface.

4. A board retainer assembly of claim 1 wherein said chassis member comprises a generally U-shaped channel having two generally parallel opposed sides, a first said opposed side providing said board clamping surface, a second said opposed side slidably engaging said clamp member, said wedge actuator being pivotally attached to said second opposed side.

5. A board retainer assembly of claim 4 wherein said biasing element includes a bearing wall extending generally parallel with said second opposed side, said bearing wall and said second opposed side establishing therebetween a channel, said clamp member being slidably retained within said channel.

6. A board retainer assembly of claim 1 wherein said biasing element is generally rigidly mounted to said chassis member, and said contact element is resiliently

mounted to said clamp member.

7. A board retainer assembly of claim 1 wherein said chassis member is formed from a continuous sheet of material, and said biasing elements are unitary with said chassis member.

8. A board retainer assembly of claim 1 wherein said clamp member is formed from a continuous sheet of material, and said contact elements are unitary with said clamp member.

9. A board retainer assembly of claim 1 wherein said wedge actuator is mounted in said assembly through an over the center detent mechanism.

10. A board retainer assembly of claim 1 including an engagement pin on said wedge actuator, said engagement pin being adapted to engage said clamp member for slidably actuating said clamp member when said wedge actuator is moved between said locked and unlocked positions.

11. A board retainer assembly of claim 10 wherein said wedge actuator includes at least one protrusion adapted for snapped engagement with said chassis member when said wedge actuator is in said locked postion.

12. A board retainer assembly of claim 4 wherein said chassis member includes a right and left end, each of said right and left ends being adapted for pivotal attachment with said wedge actuator, said clamp member adapted to being slidably actuated by moving said wedge actuator.

13. A board retainer assembly of claim 12 wherein said biasing element and said second opposed side establish therebetween a channel, said clamp member being slidably retained within said channel.

14. A quick release board retainer assembly, comprising:

a generally U-shaped chassis member including at least one fixed biasing element unitary with said chassis member and two generally parallel opposed sides, a first said opposed side providing a board clamping surface, said biasing element including a bearing wall and a cage element, said bearing wall being generally parallel with a second said opposed side, said bearing wall and said second opposed side establishing therebetween a channel;

a locking arm attached to said chassis member, said locking arm being pivotally moveable between a locked position and an unlocked position; and

a clamp member having an elongated body slidably

retained within said channel by said cage element, said clamp member including at least one cantilever mounted resilient leaf spring finger disposed in wedging relationship to said biasing element and actuated by movement of said locking arm, said leaf spring finger being adapted to resiliently urge said board against said clamping surface when said locking arm is in said locked position.

15. A quick release board retainer assembly of claim 14, wherein each of said U-shaped channel chassis member and said clamp member is independently formed from its own continuous sheet of material.

16. A universal quick release circuit board retainer assembly, comprising:

a generally U-shaped channel chassis member including at least one substantially rigidly mounted biasing element integral with said chassis member and two generally parallel opposed sides, a first said opposed side providing a board clamping surface, said biasing element including a bearing member and protruding extension, said bearing member being generally parallel with a second said opposed side establishing therebetween a channel, said chassis member having a right and left end;

a locking arm adapted to being mounted to said chassis

member at either said right or left ends, said locking arm being moveable between a locked and an unlocked position;

a clamp member having an elongated body slidably retained within said channel by said protruding extension, said clamp member including at least one unitary cantilever mounted resilient leaf spring finger disposed in wedging relationship to said biasing element and adapted to being actuated by movement of said locking arm between said locked and unlocked positions, said leaf spring finger being adapted to resiliently urge said circuit board against said clamping surface when said locking arm is in said locked postion.

FIG. 1

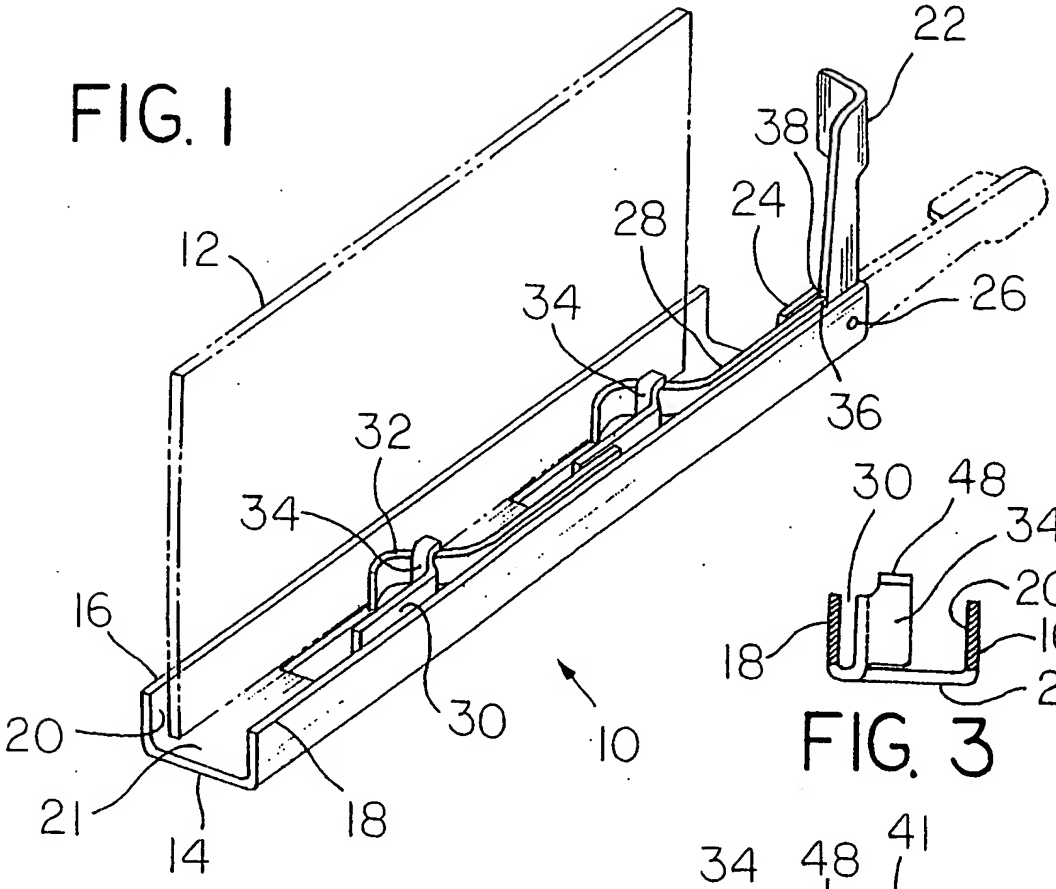

FIG. 3

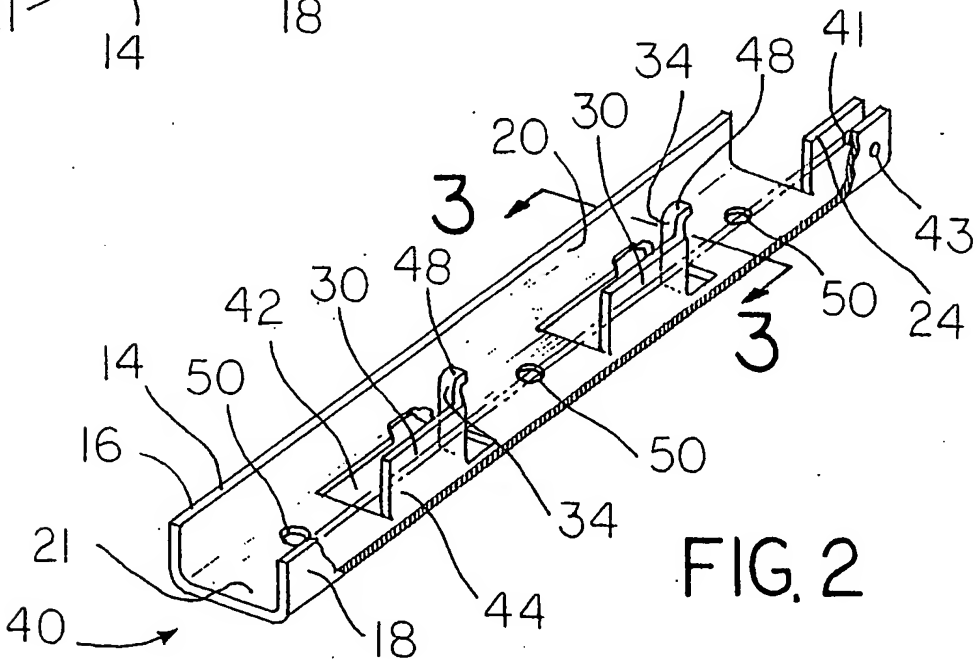

FIG. 2

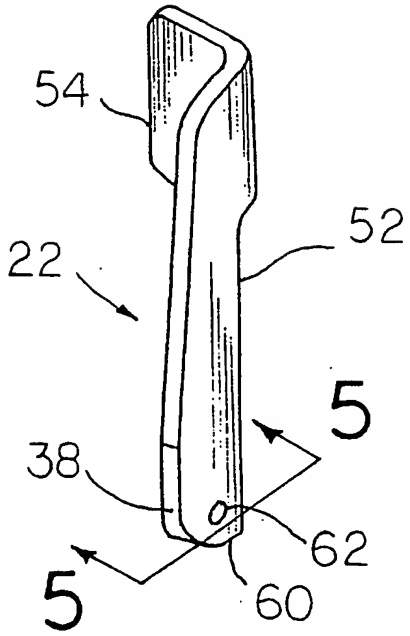

FIG. 4

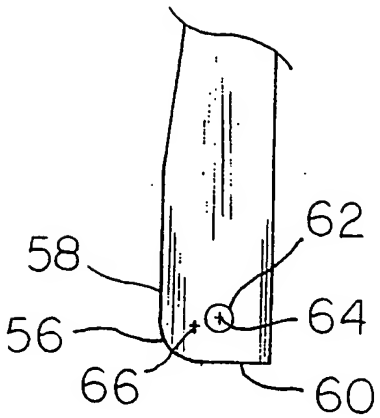

FIG. 5

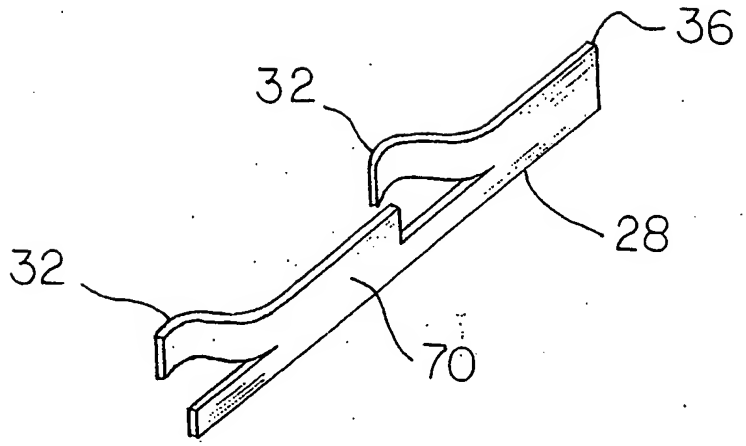

FIG. 6

FIG. 7

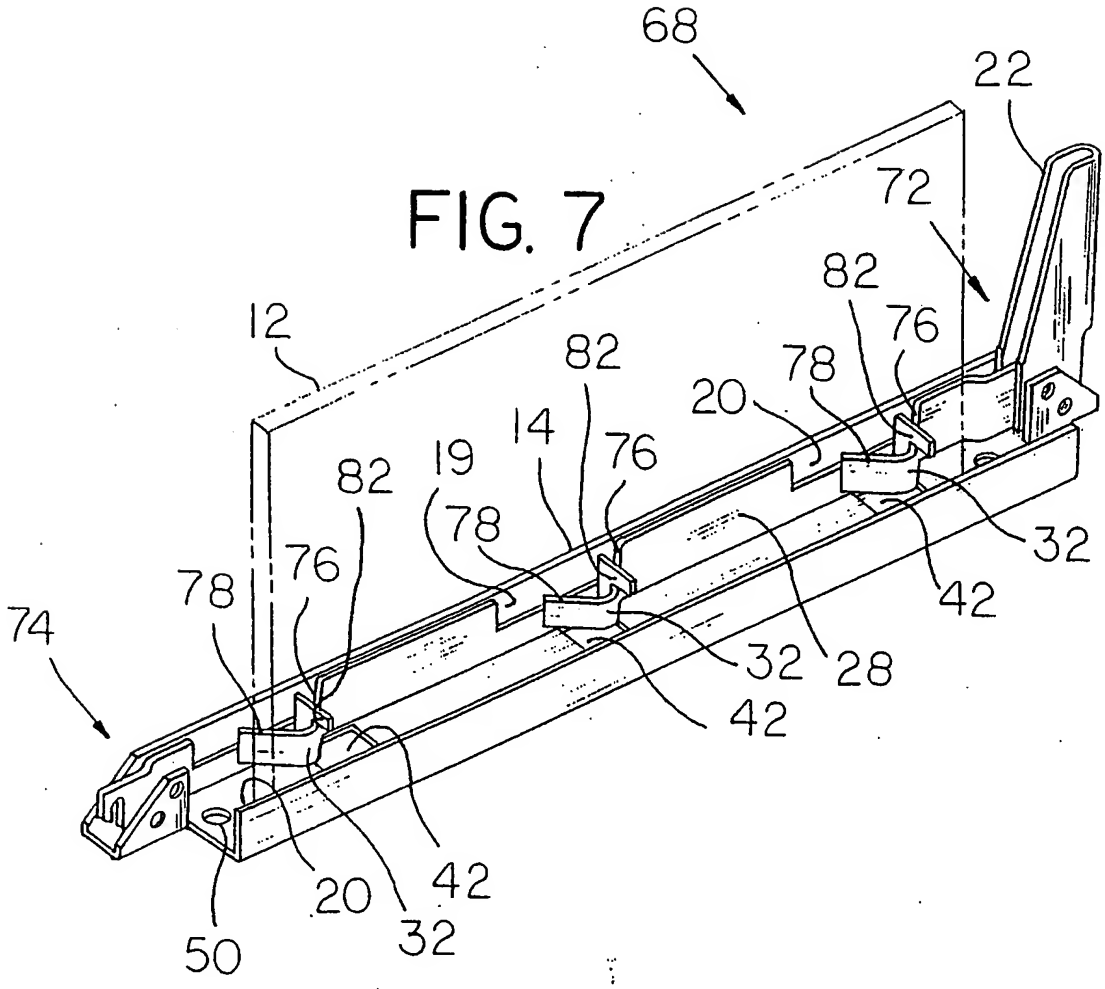
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FIG. 8

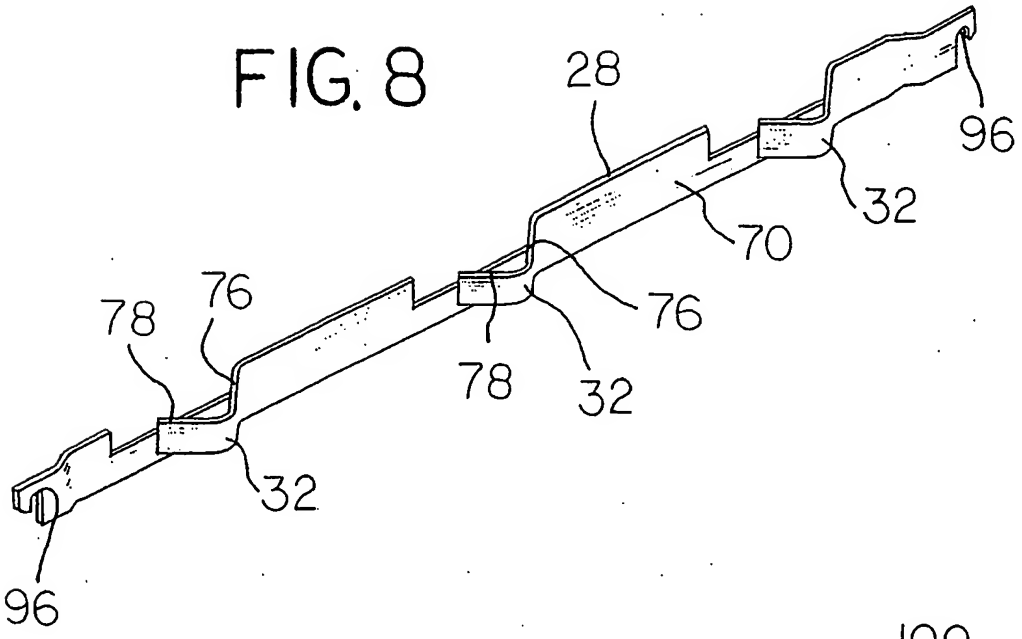

FIG. 9

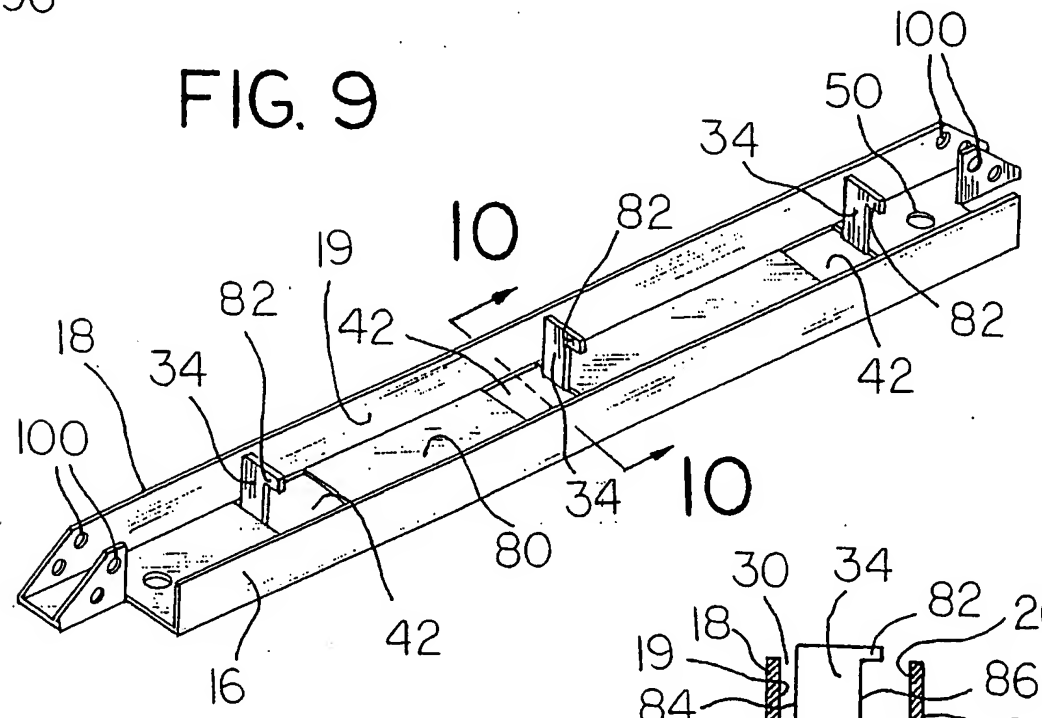

FIG. 10

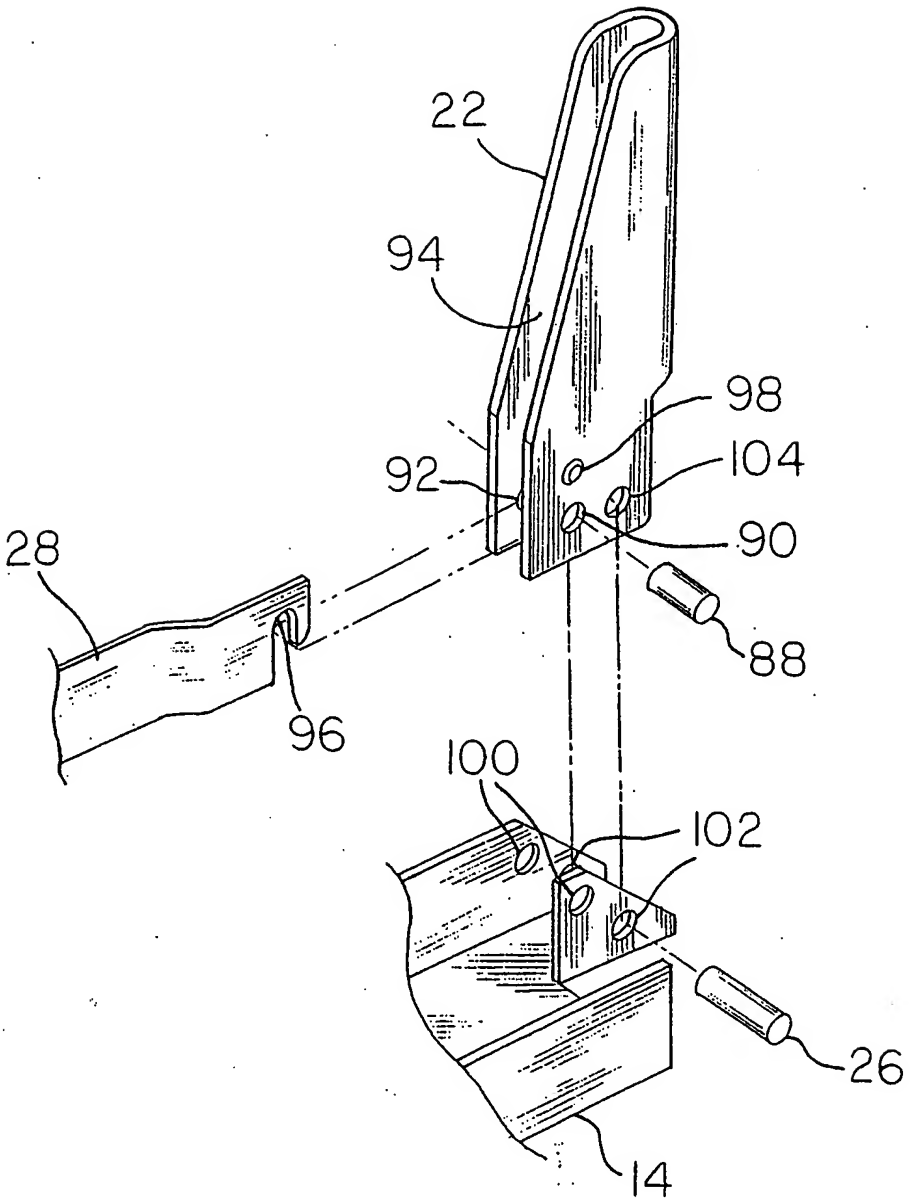

FIG. 11

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/14001

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :A47G 19/08, 29/00; H05K 5/00, 7/14; H01R 13/64
US CL :211/41.17; 248/694; 361/756, 802; 439/377

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 211/41.17; 248/681, 694; 361/741, 754, 756, 759, 787, 801, 802; 439/61, 377; 403/322.4, 325, 329, 330

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 5,402,319 A (SHUMAKER et al) 28 March 1995 (28.03.1995), Figures 5 and 6.	1, 2, 4-11, 14 and 15 ----- 3, 12, 13 and 16
Y, P	US 5,883,784 A (HUGHES et al) 16 March 1999 (16.03.1999), Figure 2.	3
Y	US 5,542,854 A (BOWEN) 6 August 1996 (6.08.1996), Figure 1.	12, 13 and 16
Y, P	US 5,796,593 A (MILLS et al) 18 August 1998 (18.08.1998), Figure 2.	16
A, P	US 5,889,656 A (YIN) 30 March 1999 (30.03.1999), Figure 1.	

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 19 AUGUST 1999	Date of mailing of the international search report 22 OCT 1999
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer JENNIFER E. NOVOSAD Telephone No. (703) 305-2872

Form PCT/ISA/210 (second sheet)(July 1992)*

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/14001

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5,533,631 A (MARCHETTI) 9 July 1996 (9.07.1996), Figure 5.	
A	US 5,467,254 A (BRUSATI et al) 14 November 1995 (14.11.1995), Figure 3.	
A	US 5,187,648 A (ITO) 16 February 1993 (16.02.1993), Figure 2.	